

What is The Physical Time: An Energy, An Interaction, A Particle or An Effect of Energy-Particle Duality?

Name : Prasenjit Debnath

Designation : PhD Student

Organization : NIT Agartala, India

Email ID : prasenjit1001@yahoo.com

Abstract — What the physical time is all about? Is it energy? Or is it an interaction? Or is it a rather simply particle? Or is it an effect of energy-particle duality? Is it possible that the goal of theoretical physics related to the physical time can be achieved in the not-too-distant future? At the beginning of the Nineteenth century, it was believed that the continuum mechanics could explain everything of the Universe. All we need to measure some parameters or coefficients like viscosity, conductivity, elasticity etc. The interactions such as electromagnetism and gravitation are of long range which means that the fields produced by a large number of matter particles can all add up to give a field which can be detected on a macroscopic scale. And this is the reason that the first theories developed for them: the gravity by Sir Isaac Newton in the seventeenth century and electromagnetism by Maxwell in the nineteenth century. However, these both theories are incompatible to each other because the Newtonian theory of gravitation is invariant if the whole system such as the Universe is given a uniform velocity, whereas the Maxwell theory of electromagnetism defines a preferred velocity- the velocity of light (300,000 km/second). At the end, it was Newtonian theory of gravity that had to be modified to make compatible with the invariance property of Maxwell theory of electromagnetism. This was achieved by Einstein's general theory of relativity on gravity, which was proposed in 1915. The problem arose when one tried to apply such classical theories, like Newtonian theory or Maxwell theory, to construct the model of an atom. These theories predict that the electrons radiate electromagnetic waves while orbiting around the nucleus very like the Earth orbiting the Sun in the solar system. These electromagnetic waves would carry away energy and would cause the electrons to spiral into the nucleus, producing the collapse of the atomic structure. This problem was overcome by what is called the greatest achievement of the theoretical physics in the twentieth century: the discovery of the quantum theory which basically based on the uncertainty principle that predicts that the quantities such as velocity and position cannot be measured accurately simultaneously, the more accurate we measure one, the less accurate will be the other. In the case of the atom, this means that in the lowest energy state of an electron, it cannot be at rest in the nucleus because, in that case, its position would be completely defined (in

the nucleus) and its velocity would be exactly defined (to be zero in the nucleus). So, because of the uncertainty principle, the electron cannot radiate energy in the form of electromagnetic waves, because there is no lower energy state for electron to go to.

Keyword — The physical time, Electromagnetism, the Newtonian theory of gravitation, the general theory of relativity, the velocity of light, matter and energy, The quantum theory, uncertainty principle, waves, energy state.

1. INTRODUCTION

The macroscopic scale structural homogeneity of the Universe makes it very difficult to believe that it is determined by anything that is as peripheral as some complicated molecular structures on a minor planet orbiting a very average star in the outer suburbs of a fairly typical spiral galaxy, the Milky Way [1]. Although we do not have yet the quantum theory of gravity, still, we do have an idea of some of the features, it should possess [2, 3]. The big question is why gravity affects only the causal structure of space-time i.e. why gravity determines which events are causally related to one with the other [4, 5]. For example, we know that when particle and anti-particle annihilate, the annihilation leaves with pure energy that radiates around the Universe [6]. In the Black holes, the gravity is so intensely strong that even light cannot be escaped from that [7]. The intense gravitational field constantly converts pure energy into particle and anti-particle pair [8], the anti-particle falls into the Black hole, and particle escaped from the black hole to the arbitrary infinity [9, 10]. For human observers, it seems that the particle is coming out of the black hole which validates the sentence, 'The Black Holes aren't so black at all'. Thus, the Black holes when consumes the anti-particle, reduces its mass to release the equivalent energy. That is the reason that the dark matters (a kind of black holes) is said to be fueling the Universe expansion in an inflationary manner. There is experimental evidence of the presence of the dark matter in billion billion of galaxies in the Universe. In our galaxy, the Milky Way too have evidence of the presence of the dark matters- the variation of the speed between the calculated speed of the observable matter of the galaxy and the experimental evidence of the actual speed of the galaxy, makes it clear that there is a lot more mass than that of which is observable by us. The dark matter's intense gravitational field is so high that even light cannot be escaped from it, makes it pure dark for us, and

thus these matters are not directly detectable, but can be felt their presence indirectly. The intense gravitational field of the black holes or dark matters makes half of the information lost to the dark matter because of consumption of the anti-particle. The remaining other half information obeys uncertainty principle; means the more accurate we calculate the position, the proportional less accurate we can measure the velocity, thus again halved the information for us. These means that we are left with probabilistic solution only, the statistical prediction, made us to rely again on the anthropic principle that we are here because the world is that way it is and the intelligent life is here to ask the big question ‘Why we are here?’[11]. Another big concern is if there is only probabilistic solution left with us, then is the end in sight for theoretical physics? [12, 13] We understand our limitations. We know Earth means that we know the surface of the Earth only. If we know the only surface, we normally encounter the land only to have a proper address. If we know the land, we know a tiny little part of the land to have cities to live comfortably, to have architectural structure with so called proper address. If it is our reality, is it feasible for us to explore the Universe with very low speed space rockets compared to the light speed? The problem with too intelligent creatures is that if they have a wrong way at the beginning of the imagination in a long calculation, they will end up with infinitely wrong conclusion which is purely waste of intelligence, it would have been a curse to be intelligent. If we have to rely only on probabilistic statistical solution, it is nothing wrong to paraphrase Voltire’s philosophy that ‘We live in the most probable of all possible worlds’ [14, 15].

2. WHAT IS THE PHYSICAL TIME?

Our attempts in modeling of the physical time can consist of the following parts: first, a set of local laws that are obeyed by the physical time which are usually can be formulated in various mathematical equations [16]. Secondly, we have to find the set of boundary conditions that tell us the states of some regions of the Universe related to the physical time and what effects propagate into it subsequently from the rest of the Universe [17]. From the atomic structure, we do know now that electrons exchange virtual particle to repel each other, thus seemingly stable in their orbit, at the same time, the electrons exchange virtual particle between electrons and protons to attract each other, thus both are in a bound state and also electrons and protons exchange virtual particles to behave the neutrons to be charge neutral [18]. Although the atom seemingly stable in present state, it will have a lifetime of 10^{31} years for electrons to decay completely into energy [19]. We do know that gravity exists due to exchange of virtual particle (graviton) between masses [20]. So, we have two types of particles, first, matter particle such as quarks, electrons, muons etc. that are responsible for masses and the virtual particles

that is exchanged among matter particles to have interaction among them[21]. Also the interactions are divided in phenomenological way into four categories: the strong nuclear forces, weak nuclear forces, the electromagnetic fields and the gravity. Because gravity affects space-time to be bent and because graviton is a virtual particle, the physical time is also a particle. Now, gravity is an interaction between matter-particles, thus gravity is a virtual particle. The physical time is a good resemblance of gravity. The physical time divides events (an interaction of matter particles) into broadly causal and non-causal [22]. So, the physical time is a virtual particle that cannot be detected by observations but the effect can be felt. Because the virtual particles have a property of wave propagation, thus the physical time has the property of wave propagation. The physical time propagates as wave with the expanding observable Universe. For intelligent life like human beings, the physical time means the psychological recognition of the original physical time’s wave propagation of the virtual particles, the physical time. So, as the physical time is virtual particle, it behaves like energy as well as particles. By combining both, the physical time is nothing but energy-particle duality. It has mass which is not directly detectable because it is virtual particle which is outside of the scope of particle detector till date. It has visible effect on gravity, because as gravity adds its effect with the masses (the reason it can be felt on a macroscopic scale), similarly, the relative mass get changed of the wave-propagated virtual particle: the physical time with gravity, thus the physical time’s macroscopic effect can also be detected. The physical time runs slow with interaction of masses compared to absolute vacuum as the reference frame. The proportion of slowness of the physical time with interaction with masses is directly proportional to the amount of mass. This slowness of the physical time can be shown as imaginary time in an X-Y coordinate system, where the magnitude of the slowness of the physical time is directly proportional to the magnitude of the physical time component on the imaginary axis of X-Y coordinate system. So, the approach is that we can represent the physical time with coordinates like X-Y axis or polar coordinates [23] and hence graphical representation of the physical time itself is possible with the two-dimensional approach of the physical time. Thus, the physical time is nothing but exchange of virtual particles among matter particles exactly similar way the gravity does. If we can change the exchange rate of the virtual particle responsible for the physical time, we will be able to make the physical time runs fast or slow with compared to the normal rate of reference and that will be independent of observers as predicted by the general theory of relativity. And which means that the observers will not have their own measure of the physical time. So, the physical time is no more observer dependent reality.

4. CONCLUSION

The physical time is basically an interaction of virtual particles among matter particles which cannot be directly detected by particle detector but its presence can always be felt. If we can formulate the quantum theory of gravity, we can correlate the physical time with gravity to have quantum theory of the physical time which propagates as waves with the inflationary expanding Universe. The physical time runs at different speed with interaction of the gravitational fields of masses. If we do not have the complete human behavior summarized in a branch of applied mathematics, it is highly unlikely to have complete theory of everything that is compatible with all possible observations. But from a positivist point of view, we must try for a complete theory of everything that describes properly all possible events around the Universe. The matter particles are described by fields of one-half-integer spin and they all obey Pauli Exclusion Principle which prevents any particle to be in any other state of the same kind of particles. Basically, this is the reason that solid bodies can retain their own identity, does not collapse to a point or radiate away to the infinity- reason of the stability of matter particles. Whereas the interactions are represented by integer-spin fields and they do not obey the Pauli Exclusion Principle which means that they can have many particle of the same state. Like gravity, the physical time can be represented with fields of integer spin particles. All we need to find the quantum theory of gravity to correlate it with the quantum theory of the physical time that should be the ultimate theory that describes the physical time completely.

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REFERENCE

- [1] Stephen Hawking, "Black holes and Baby Universes and other essays", Bantam Press, London 2013, pp. 42-61. ISBN 978-0-553-40663-4
- [2] Stephen Hawking, "A Brief History of Time", Bantam Books, London 2011, pp. 156-157. ISBN-978-0-553-10953-5
- [3] Stephen Hawking, "The Grand Design", Bantam Books, London 2011
- [4] Stephen Hawking, "The Universe in a Nutshell", Bantam Press, London 2013, pp. 58-61, 63, 82-85, 90-94, 99, 196. ISBN 0-553-80202-X
- [5] Stephen Hawking, "Stephen Hawking's Universe: Strange Stuff Explained", PBS site on imaginary time.
- [6] Stephen Hawking, "The Beginning of Time", A Lecture.
- [7] Gerald D. Mahan, "Many-Particle Physics", Third Edition, Springer, 2000
- [8] A. Zee, "Quantum Field Theory in a Nutshell", Princeton University Press, 2003
- [9] Uno Ingard, K "Fundamental of Waves & Oscillations", Cambridge University Press. P. 38, ISBN-0-521-33957-XOxford: The British Academy, 1999
- [10] Craig Callender, "Time, Reality and Experience", Cambridge, UK: Cambridge University Press.
- [11] Storrs McCall, "A Model of the Universe", Oxford: Clarendon Press, 1994
- [12] Craig Callender, "Thermodynamic Asymmetry in Time", The Stanford Encyclopedia of Philosophy (Spring 2002 Edition)
- [13] Storrs McCall, "A Model of the Universe", Oxford: Clarendon Press, 1994
- [14] Robin Le Poidevin and Murray McBeath, "The Philosophy of Time" Oxford: Oxford University Press, 1993
- [15] Barry Dainton, "Time and Space", Ithaca: McGill-Queen's University Press, 2001
- [16] Newton-Smith, W.H., "The Structure of Time". London: Routledge & Kegan Paul, 1980.
- [17] Robin Le Poidevin, "Questions of Time and Tense", Oxford: Oxford University Press, 1998.
- [18] Nehrlich, Graham, "What Spacetime Explains". Cambridge: Cambridge University Press, 1994.
- [19] William L.Craig, "Time and the Metaphysics of Relativity", Dordrecht: Kluwer Academic Publisher, 2001
- [20] Whitrow, G., "The Natural Philosophy of Time". Oxford: Oxford University Press, 1961. (2nd edn., 1980.)
- [21] Smart, J. J. C., "Problems of Space and Time". London: Macmillan, 1964
- [22] Stephen Hawking, "A stubbornly persistent illusion-The essential scientific works of Albert Einstein", Running Press Book Publishers, Philadelphia, London 2011.
- [23] Sklar, Lawrence, "Space, Time, and Space-time". CA: University of California Press, 1974.

AUTHOR'S PROFILE



I, Prasenjit Debnath, born in Agartala, Tripura, India on 15th of March 1979. I am pursuing a Ph.D. degree in the Department of Physics in National Institute of Technology Agartala (NIT Agartala), India.